

A REVISION OF THE FOSSIL PLANTS OF THE GENERA
ACROSTICHOPTERIS, TENIOPTERIS, NILSONIA, AND
SAPINDOPSIS FROM THE POTOMAC GROUP.

By EDWARD W. BERRY,

Of the Johns Hopkins University, Baltimore.

The present paper is the second of a series of revisions of the more important genera of fossil plants from the Potomac group in Maryland and Virginia. The first dealt with the genus *Nageiopsis* and formed No. 1738 of the present volume of the Proceedings. The material upon which these studies are based is nearly all contained in the U. S. National Museum collections, but the collections of the Johns Hopkins University and the Maryland Geological Survey have also been utilized.

The following pages are devoted to the genera *Acrostichopteris*, *Teniopteris*, *Nilsonia*, and *Sapindopsis*. Of these the fern genus *Acrostichopteris* and the dicotyledonous genus *Sapindopsis* were founded upon collections from the Potomac strata to which they are largely confined. The fern genus *Teniopteris* and the cycad genus *Nilsonia* have not been previously recognized in the Lower Cretaceous of eastern North America, the specimens upon which the present determinations are based having been previously wrongly correlated with the genera *Angiopteridium*, *Anomozamites*, and *Platypterigium*.

THE GENUS ACROSTICHOPTERIS OF FONTAINE.

This genus is characterized as follows by its describer:

Fronds probably creeping, with very long, often flexuous rachises, which seem to have been more or less succulent; pinnae going off obliquely, long and apparently slender; ultimate pinnae or pinnules subopposite to alternate, comparatively short, and cut down nearly to the rachis into more or less cuneate-flabellate pinnules or primary segments. These are divided generally into cuneate-flabellate segments, which in turn are separated into oblong segments ending in oblong, or ovate-obtuse, or acute teeth; pinnules decurrent and forming a wing; nerves slender but distinct, flabellately diverging, forking dichotomously, and ending in the teeth; fructification occurring on the basal segments of the pinnules, in the upper portions of the frond on the upper one alone, in the lower portions on the upper and lower ones, the fructified segments close appressed to the principal rachis. The fructified segments are so modified as to take the

form of leathery, rounded, or elliptical segments, which on the lower side are covered by the naked sori, and seen from the upper side, especially when compressed on the clay, look like pods.^a

The fructification characters should be modified to include those of *Acrostichopteris pluripartita*, which appear to represent entire pinnules reduced to fertile segments and not merely basal lobes of otherwise sterile pinnules thus transformed, as appears to be the case in *Acrostichopteris longipennis*.

With all the collected material at hand it is difficult to see any conclusive evidence that the species included in this genus were creeping in habit or had succulent rachises or that the fertile segments were covered with naked sori. There is some evidence as to fructification characters, but this is most indefinite as regards details, and it may be noted that what are called nut-like seeds when applied to fragments referred by this author to his genus *Baieropsis* are described as above for fragments which he referred to the present genus, although neither the fertile nor the vegetative parts are distinguishable with certainty in these two supposed genera.

All of the species which constituted the genus *Baieropsis* of Fontaine, except *Baieropsis expansa* and *Baieropsis macrophylla* are referred to *Acrostichopteris* in the present paper, with which they are obviously allied in instances where they are not actually identical. They present no characters which are clearly those of the order Ginkgoales except their subdivided fronds, which are suggestive of *Baiera* or *Jeanpaulia*, but might equally suggest various living Polypodiaceæ, as, for instance, *Actinopteris* and *Rhipidopteris* or the various species of *Schizæa* of the family Schizæaceæ. Among fossil species they are very similar to forms referred to *Sphenopteris*, *Palmatopteris*, etc. Considerations which point away from *Baiera* in the direction of the ferns are the fine inequilateral outline of the leaves (pinnules), their decurrence, and their arrangement in a pinnate manner in a single plane. The two species *Baieropsis expansa* and *macrophylla* furnish fructified specimens which clearly indicate their reference to the family Schizæaceæ. These will be fully discussed in another place.

With regard to the botanical position of *Acrostichopteris* little is known. According to Fontaine:

The genus in the naked sori is like *Polypodium*, but in most features stands nearest to *Acrostichum*, much resembling the section *Rhipidopteris*. In this latter, however, the fructification is borne on separate pinnules. If we place the fructified pinnules of *Rhipidopteris* as basal segments on the sterile ones, we have a form strikingly like *Acrostichopteris*. This genus has also some resemblance to *Marsilea*.

Seward^b on the strength of Fontaine's conclusions as quoted above places the genus in the Polypodiaceæ, and the present writer in the

^a Monogr. U. S. Geol. Surv., No. 15, 1890, p. 106.

^b Seward, Wealden Flora, pt. 1, 1894, p. 60.

absence of better data has followed the same course, although the definite reference of the two species of *Baieropsis* above mentioned to the Schizæaceæ throws doubt upon all the other similar forms. Potonié^a places the genus as a synonym of his *Palmatopteris* in the artificial group of Sphenopterides.

Aerostichopteris may be compared with the modern *Actinopteris*, a monotypic genus of the Indoafriean steppes, with the neotropical genus *Rhipidopteris*, or with *Schizæa dichotoma* Swartz., and *Schizæa elegans* Swartz., of the family Schizæaceæ. It is not closely related to *Aerostichophyllum* Velenovsky (1889) of the Cenomanien of Bohemia. As here delimited it is purely a form genus embracing five species in the Maryland-Virginia region. Of these, two species are confined to the basal beds or Patuxent formation, two species range through the whole Lower Cretaceous of this region and are present as well in both the Lakota and Fuson formations of the Black Hills region, and one species is confined to the Patapsco formation and is widespread in its occurrence. One additional species, suggestive of *Aerostichopteris parvifolia* of the Patuxent and likewise close to the only remaining species, *Aerostichopteris ruffordi* Seward^b of the English Wealden, has recently been described by Knowlton^c from the Kootenai of Montana. Considering for a moment the Portuguese homotaxial deposits we find a considerable number of remarkably similar forms described by Saporta^d, all of which are referred to the form-genus *Sphenopteris*. Thus from the Upper Jurassic there is *Sphenopteris tenellisecta* Saporta, from the Urgonien *S. cuneifida* Saporta, from the Aptien *S. flabellisecta* Saporta, *S. tenuifissa* Saporta, and *S. debilior* Saporta. These forms are certainly congeneric with *Aerostichopteris* and with more representative material doubtless some species would be found to be common to both sides of the Atlantic. Some are more nearly like the forms segregated by Fontaine to form his genus *Baieropsis*, while others are of the type which this author referred to *Aerostichopteris*.

ACROSTICHOPTERIS LONGIPENNIS Fontaine emend,

Aerostichopteris longipennis FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 107, pl. 170, fig. 10; pl. 171, figs. 1, 5, 7.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 557.

Aerostichopteris densifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890 (part), pl. 170, fig. 11; pl. 171, figs. 2, 6; pl. 172, fig. 13 (not pl. 94, fig. 4, which is referable to *A. parvifolia* Fontaine).

Aerostichopteris parvifolia FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 558, pl. 116, fig. 5.

^a Potonié in Engler and Prantl, 1902, p. 490.

^b Seward, Wealden Flora, pt. 1, 1894, p. 61, pl. 6, fig. 3.

^c Knowlton, Smiths. Misc. Coll., vol. 50, 1907, p. 110, pl. 9, figs. 3, 3a.

^d Saporta, Flora Foss. Portugal, 1894, pp. 25, 69, 127, 160, 161.

Baieropsis foliosa FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 209, pl. 93, figs. 4-6.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 481, 482, 489, 501, 508, pl. 110, fig. 9.

Baieropsis denticulata angustifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 210, pl. 112, fig. 7.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 491.

Description.—Fronds with relatively long pinnae, decomposed proximad and becoming simpler distad, the ultimate pinnules subopposite to alternate, rather close set. Pinnules inequilateral and slightly decurrent, cut into several narrow sublinear divisions and terminated by two or more subacute teeth. The lower pinnules are wider and more lacinate and more decidedly alternate on the stout rachis. Venation fine, but distinct, flabellate and dichotomous, ultimate divisions terminating in the apical teeth. The sterile and smaller specimens tend to much greater density than those of larger size or those showing traces of fructifications. The fructifications, which are illy defined in the coarse matrix, are borne on the proximal or distal or both basal segments of the pinnules; the segment or segments involved become wider and shorter and elliptical in outline. No details can be made out.

This species is exceedingly common in the Patapsco formation to which it is confined, being especially common in the beds of this age at Federal Hill, to which locality it is largely confined in the Maryland area. In Virginia it occurs at a large number of localities within this formation.

It is difficult to see upon what evidence, unless it be the supposed relation with the modern *Rhipidopteris*, led Fontaine to claim a creeping habit for these forms. The rachis is sometimes more or less flexuous but not markedly so, and the length is relatively great. Proximally, however, the rachis becomes stouter with decomposed pinnae as broad or broader than they are long. It seems probable that this form was not a ground dweller with creeping rachis or rhizome nor did it adhere to tree trunks, but reclined or clambered over the abundant erect Lower Cretaceous vegetation as does the modern *Lygodium*. It appears to be closely related to *Sphenopteris debilior* Saporta^a of the Albien of Portugal.

Occurrence.—PATAPSCO FORMATION. Near Wellhams, Federal Hill, Maryland. Near Brooke, 72d milepost, Hell Hole, Mouth of Hell Hole?, White House Bluff, Dumfries Landing, Aquia Creek cut, and Mount Vernon, Virginia.

Collections.—U. S. National Museum, Johns Hopkins University.

^a Saporta, Flora Foss. Portugal, 1891, p. 161, pl. 28, figs. 5, 5a.

ACROSTICHOPTERIS ADIANTIFOLIA (Fontaine).

Baieropsis adiantifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 211, pl. 92, figs. 8, 9; pl. 93, figs. 1-3; pl. 94, figs. 2, 3. FONTAINE, in WARD, 19th Ann. Rept. U. S. Geol. Surv., 1899, pt. 2, p. 684, pl. 168, fig. 8. FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 18, 1905, pp. 510, 528, 538.

Description.—The original description by Fontaine in 1890 is as follows:

Stems moderately strong; leaves subopposite to opposite, closely placed, often imbricated, subquadriangular to flabellate fan-shaped, narrowed to a wedge-shaped base, and attached by a short pedicel which springs from the lower corner of the leaf, so that the inner margin of the leaves runs close to the main stem, parallel with it, and often overlapping it, while the lower margin of the leaves stands nearly at right angles with the main stem; leaves cut down to near the base into two principal laciniae, and those higher cut into two or more minor laciniae; ultimate laciniae very shallow and strap-shaped, ending in acute very short teeth, or rarely in narrowly elliptical and subacute ones; all the laciniae turned outwards or upwards, the lower margins of the leaves being entire or having sometimes an acute tooth; leaves in ascending towards the tips of the leafy branches have their lower margins directed more and more upwards, become smaller, assume more of an elliptical or a wedge shape, have the laciniae only on the upper margin, and finally coalesce to form a terminal leaflet, which at base shows three segments, but whose terminal portions are not seen; nerves fine but distinct, branching at base from a mother nerve and then dividing repeatedly in a dichotomous manner so as to fill the laminae, and have the branches ending in the teeth.

The plant is most frequent at Fredericksburg but is not abundant there, and is usually in a very fragmentary state. If we look to the shape of the leaves alone this curious plant is much like a fern of the type of *Adiantum*, but the gradations through different forms connect the specimens so closely with the flabellate leaves of *Baieropsis* that they can not be separated by any good distinctions. The principal difference from the more common and typical forms of *Baieropsis* is found in the greater proportional width of the leaves and the smaller depth of the subdivision.

This species is based upon very fragmentary specimens and it is very doubtful if the material identified from the Patapsco and Arundel formations is the same as that from the Patuxent, the presence of this species from Chinkapin Hollow, Virginia, and Arlington and Fort Foote, Maryland, being each based on a single very poor specimen.

Occurrence.—LAKOTA FORMATION. Barrett and Hay Creek, Wyoming.—PATUXENT FORMATION. Fredericksburg, Potomac Run, Telegraph Station, Virginia.—PATAPSCO FORMATION. Fort Foote, (?) Maryland and Chinkapin Hollow, (?) Virginia.—ARUNDEL FORMATION. Arlington, (?) Maryland.

Collections.—U. S. National Museum.

ACROSTICHOPTERIS CYCLOPTEROIDES Fontaine emend.

Acrostichopteris cyclopteroides FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 109, pl. 94, fig. 8.

Baieropsis denticulata FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 210, pl. 93, fig. 7.

Description.—Pinnules rounded, fan-shaped, cyclopteroid, divided into two or three principal segments which are split up into six or more subordinate linear oblong divisions terminated by subacute teeth. Rachis stout. Venation flabellate, the single vein which enters the base repeatedly forking dichotomously, the ultimate divisions entering the teeth.

This species is poorly characterized and is based upon infrequent and very fragmentary material from the single locality cited. It may well represent a slightly variable form of pinnule of one of the other more abundant Patuxent species, as, for instance, *Acrostichopteris parvifolia* Fontaine. In the foreign Cretaceous it is rather remotely suggestive of *Sphenopteris flabellina* Saporta^a from the Albien of Portugal.

Occurrence.—PATUXENT FORMATION. Dutch Gap, Virginia.

Collections.—U. S. National Museum.

ACROSTICHOPTERIS PARVIFOLIA Fontaine emend.

Acrostichopteris parvifolia FONTAINE, (part), Monogr. U. S. Geol. Surv., No. 15, 1890, p. 108, pl. 94, figs. 5, 9, 10, 12; pl. 171, figs. 3, 4; pl. 172, fig. 4 (not Fontaine, in Ward, 1906).

Acrostichopteris densifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, pl. 94, fig. 4 (not balance of figures).

Baieropsis adiantifolia minor FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 212, pl. 94, fig. 1.

Acrostichopteris parcelobata FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 108, pl. 94, figs. 6, 7, 11, 14.

Description.—Pinnules small and generally remote, the distal ones short, all divided into three principal lobes, which are variously dissected and terminated with two or more short stout teeth. Venation, as usual in this genus.

This species is thus far confined to the Patuxent formation of Virginia, the specimens from Maryland so identified by Fontaine proving to belong to *Acrostichopteris longipennis*, which is somewhat similar in appearance but usually much more dense in habit.

The remains are rare and fragmentary at all of the recorded localities except Dutch Gap Canal, where they are not infrequent. They show no traces of fructifications. This species is very closely related to *Acrostichopteris fimbriata* Knowlton^b of the Kootenai formation of

^a Saporta, Flora Foss. Portugal, 1894, p. 160, pl. 28, figs. 3, 6.

^b Knowlton, Smiths. Misc. Coll., vol. 50, 1907, p. 110, pl. 11, figs. 3, 3a.

Montana, and likewise to *Acrostichopteris ruffordi* Seward^a of the English Wealden. On the continent it is represented by the nearly allied and strictly congeneric species *Sphenopteris tenellisceta* Saporta^b from the Upper Jurassic, and *Sphenopteris flabellisceta* Saporta^c from the Aptien of Portugal.

Occurrence.—PATUXENT FORMATION. Dutch Gap, Fredericksburg, Trents Reach, Potomac Run, Virginia (not Federal Hill, Maryland).

Collections.—U. S. National Museum.

ACROSTICHOPTERIS PLURIPARTITA (Fontaine).

Baieropsis pluripartita FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 208, pl. 89, fig. 4; pl. 90, figs. 2-5; pl. 91, figs. 1, 3, 4, 7; pl. 92, figs. 1, 2, 6.—? FONTAINE, in WARD, 19th Ann. Rept. U. S. Geol. Surv., pt. 2, 1899, p. 685, pl. 168, figs. 9-12.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 479, 481, 482, 505, pl. 107, fig. 1.

Baieropsis pluripartita minor FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 208, pl. 91, fig. 5; pl. 92, figs. 3, 4.

Baieropsis longifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 210, pl. 91, fig. 6.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 505, 517, pl. 111, fig. 3.

Description.—Pinnules large in size, inequilateral, fan-shaped, subopposite, at an acute angle of divergence, narrowly divided almost to the base into three principal and a varying number of narrow linear subordinate segments. Venation of the usual character in this genus, slender but distinct. The apices are usually, if not always, broken off, so that their character can not be made out. Rachis comparatively slender.

This species includes the various indefinite fertile specimens upon which Fontaine based the characters of the supposed fruits in his genus *Baieropsis*. These are clearly to be correlated with *Acrostichopteris pluripartita*, since one specimen shows a characteristic pinnule of this species. The preservation is poor, and the most that can be made out are oval bodies apparently representing reduced or transformed segments of pinnules, all the segments of which are fertile in this case and not merely the basal ones, as is shown in so many specimens of *Acrostichopteris longipennis*. Fertile specimens of the present species are, on the other hand, very rare and fragmentary.

This species is present in both the Patuxent and Patapsco formations of Maryland and Virginia. It is also recorded somewhat doubtfully from both the Lakota and Fuson formations in the Black Hills Rim of Wyoming. In Portugal Saporta describes several very similar forms. These include *Sphenopteris cuneifida* of the Urgonien-Aptien^d

^a Seward, Wealden Flora, pt. 1, 1894, p. 61, pl. 6, fig. 3.

^b Saporta, Flora Foss. Portugal, 1901, p. 25, pl. 13, fig. 1.

^c Idem, p. 69, pl. 15, figs. 14, 15.

^d Idem, pp. 69, 127, pl. 16, fig. 11, pl. 23, fig. 5.

Sphenopteris dissectiformis^a of the Aptien (?), *Sphenopteris tenuifissa*^b of the Albien and *Sphenopteris flabellina*,^c also of the Albien.

Occurrence.—PATUXENT FORMATION. Fredericksburg, Trents Reach, Dutch Gap, Virginia; New Reservoir, District of Columbia.—PATAPSCO FORMATION. Hell Hole, 72d milepost, near Brooke, Virginia. (?) Overlook Inn, Maryland.—LAKOTA FORMATION. Barrett, Wyoming.—FUSON FORMATION. Pine Creek, Wyoming.

Collections.—U. S. National Museum.

THE GENUS TAENIOPTERIS OF BRONGNIART.

Brongniart gives the following diagnosis of *Taeniopteris* in his *Prodrome*:^d

Fronde simple, entière, étroite, à bords parallèles, transversée par une nervure moyenne, forte, épaisse, qui s'étend jusqu'à l'extrémité; nervures secondaires presque simples ou bifurquées à la base, presque perpendiculaires sur la nervure moyenne.

The type was the Jurassic species *Taeniopteris vittata*; which was compared with *Danaea* and *Angiopteris* of the modern Marattiaceæ.

This diagnosis is repeated in Latin without material change in the *Histoire*.^e In a later^f work the same author institutes various comparisons with modern ferns, and points out that the genus probably includes forms of diverse botanical affinities. Three groups are recognized: (1) Those with simple fronds like *Taeniopteris vittata*, which suggests modern forms of *Acrostichum*, (2) those with pinnate or bipinnate fronds with articulated pinnae like *T. münsteri*, which Brongniart is positive is a member of the Marattiaceæ, and (3) those with nonarticulate pinnate fronds like *T. bertrandi*.

The genus has been ably discussed in its Mesozoic aspects by Saporta, Zingo, Schenk, Schimper, Seward, and other authors, the former especially, while following Brongniart's original characterization of *fronds usually simple*, considerably extends his diagnosis.^g Saporta's diagnosis is quoted in a recent work by Seward^h and need not be repeated. The latter author uses the genus in a wide sense following Nathorst in including under it such other genera as *Oleandridium*, *Angiopteridium*, *Marattiopsis*, *Danacopsis*, etc., in which the evidence of relationship seems insufficient for the use of names implying affinity with the respective modern genera. His characterization may be quoted with profit: "Frond simple or pinnate, usually lanceolate or

^a Saporta, *Flora Foss. Portugal*, 1894, p. 68, pl. 15, fig. 18; pl. 16, figs. 22, 23.

^b Idem, p. 161, pl. 28, fig. 4.

^c Idem, p. 160, pl. 29, fig. 16.

^d *Prodrome*, 1828, p. 61.

^e Brongniart *Hist. végét. foss.*, 1831, p. 262.

^f Brongniart, *Tableau*, 1849, p. 21.

^g Saporta, *Pl. Jurass.*, vol. 1, 1873, p. 430.

^h Seward, *Wealden Flora*, pt. 1, 1894, p. 122.

linear-lanceolate, apex acute or occasionally obtusely terminated; a well-marked midrib from which lateral veins are given off either at right angles or more or less obliquely; these may be unbranched or acutely forked as they pass toward the leaf margin."^a The relation of the simple species to those with pinnate fronds is uncertain, although it seems probable that they all belong to the same stock. It proves to be an almost impossible task in the absence of any but the best preserved material to distinguish between *Teniopteris*-like forms and the remains of such a cycadaceous genus as *Nilsonia*. The lateral attachment of the lamina in the former and its superior attachment in the latter are characters which are very often obscured in the process of fossilization and the usual segmentation of the *Nilsonia* fronds is also a character which is not constant.

The genus is abundant in the late Paleozoic, the Paleozoic forms having been discussed by Zeiller, White, and others, the latter author pointing out^b their probable filiation with the *Megalopteris* stock, which extends back to the Middle Devonian. Species of *Teniopteris* are abundant during the Mesozoic and occasional occurrences are recorded during the Cenozoic. It may be seriously questioned, however, whether the Paleozoic and post-Paleozoic *Teniopteris* belong to the same stock.

In the Potomac group several species have been described under the genus *Angiopteridium* which it has seemed best to refer to *Teniopteris* in the absence of all traces of fructification and the consequent lack of certainty regarding their taxonomic position. Species also occur in the Shasta beds of California and probably in the Kootenai of Montana and British Columbia. It is also a common type in the European Wealden.

Regarding the botanical affinity of the various forms of *Teniopteris* it seems very probable that the bulk of them are closely related to the Marattiaceæ, a family with which they are allied by nearly all of the authors mentioned. In fact most authors ally them directly with living genera, thus Schimper^c positively refers the Rhætic species *Teniopteris münsteri* to the modern genus *Marattia*, a conclusion which it is difficult to dispute after seeing the magnificent fruiting specimens figured by this author. Schenk,^d on the other hand, thinks this species is closest to *Angiopteris*, while Raceborski, from the study of fruiting specimens from Poland, which he identifies with this same species, is equally sure of the correctness of Schimper's conclusions. To mention one or two other instances, Schenk^e is sure that *Dauacopsis*

^a Seward, Wealden Flora, pt. 1, 1894, p. 124.

^b White, Bull. Geol. Soc. Amer., vol. 4, 1893, pp. 119-132.

^c Schimper in Zittel's Handbuch, 1890, p. 85.

^d Schenk, Die foss. Pflanzenreste, 1888, p. 30.

^e Idem, p. 35.

marantaceu (Presl) Heer from the Keuper is a true *Danaea* and it would be equally difficult to point out the differences between the modern species and the forms of *Danaea* which Zingo describes from the Jurassic of northern Italy.^a

TÆNIOPTERIS AURICULATUM (Fontaine).

Angiopteridium auriculatum FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 113, pl. 7, figs. 8-11; pl. 28, fig. 1.

Description.—Fontaine's original description is as follows:

Frond pinnate; pinnules thick and leathery, long linear, subacute, remotely placed, free to the base, auriculate at base, attached by the midrib alone; auricles of the bases of the pinnules overlapping the upper surface more or less; midrib of pinnules rather stout and rigid; lateral nerves often obscurely shown, fasciculate or bifurcate, and toward the tips simply forked.

The plant is rare at each locality, but is most common at Fredericksburg. It is something like *Pteris longipennis* Heer^b but there is no reason to think that it is a *Pteris*. It also resembles *Pecopteris salicifoliae* Oldham and Morris. The forms figured in figs. 8, 9, 11 occur at Fredericksburg; fig. 10 occurs at the locality near Potomac Run. This is different from the others in the great length of the pinnules and in the fasciculate nerves, which are bifurcate, with the branches again forking near their tips. The nerves are obscure on the upper surface of the pinnules. The main rachis is stout and keeled on the under surface, as is shown in fig. 9. On the upper surface the auricles at the base of the pinnules overlap more or less the surface of the main rachis.

No new material referable to this species has been collected.

Occurrence.—PATUXENT FORMATION. Fredericksburg and Potomac Run, Virginia.

Collections.—U. S. National Museum.

TÆNIOPTERIS NERVOSUM (Fontaine).

Angiopteridium nervosum FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 114, pl. 29, fig. 2.

Angiopteridium densinerve FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 115, pl. 29, fig. 4.

Angiopteridium pachyphyllum FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 115, pl. 29, fig. 5.

Angiopteridium strictinerve FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 116, pl. 29, figs. 8, 9 (not Fontaine in Ward, 1906).

Angiopteridium strictinerve latifolium FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 116, pl. 30, figs. 1, 5—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 241, pl. 66, figs. 8-10.

Anomozamites angustifolius FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 167, pl. 30, fig. 3 (not fig. 2).

Anomozamites virginicus FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 168, pl. 30, fig. 4; pl. 31, fig. 3.

Description.—Habit unknown, although there are indications in one or two specimens that the frond was pinnate. Pinnae (or frond)

^a Zingo, Flora Foss. Oolith., vol. 1, 1856.

^b Heer, Foss. Flora Arct., vol. 6, pt. 2, pl. 10, figs. 5-13.

^c Foss. Flora of the Rajmahal series, pl. 27, fig. 2.

linear-lanceolate to elongate-lanceolate. Length unknown, apparently ranging from 10 cm. to 30 cm. Maximum width 1.2 cm. to 5 cm. Texture coriaceous. Midrib rather stout and prominent. Lateral veins thin but distinct, especially on the lower surface, more or less closely placed, parallel, curving backward from the midrib and then straight or slightly curved upward to the margin. Angle of divergence wide, 45° to 90° . Veins either simple or forked, the forking usually near the base, both kinds often shown on a single specimen.

This species is based entirely upon very fragmentary material, which served Fontaine for the differentiation of five species of *Angiopteridium* and two species of *Anomozamites*. There is absolutely no ground for the reference of any of the material to the genus *Anomozamites* and it is all obviously identical. There is some slight variation from specimen to specimen, for example, the midrib is somewhat less stout in *Angiopteridium nervosum* and *densinerve* as delimited by Fontaine and the angle of divergence is somewhat more acute in the latter, but these are not characters of specific value. If similar recent fronds, such as those of *Oleandra*, *Angiopteris*, or *Marattia*, be examined the size of the midrib, the remoteness or closeness of the lateral veins and their angle of divergence will be found to vary through much wider limits, a single frond often exhibiting the extremes in this respect.

A single specimen from Fredericksburg, figured by Fontaine ^a and showing apparently the basal portion of three pinnae lying in the same plane and direction and two of them attached to stout bits of rachis, is the only evidence that the fronds were pinnate and not simple. These may represent aerial stalks or they may equally well be interpreted as fragments of a rhizome or a rootstock.

This species is not common in the Potomac group and is confined to the Patuxent formation. Similar remains are described from both the Knoxville and Horsetown beds of the Pacific coast and similar fragmentary specimens are described by Saporta ^b from the Valanginien of Portugal and referred to Schimper's genus *Oleandridium*. In the European Wealden there is *Oleandridium beyrichii* Schenk ^c from Germany and England which Seward refers to *Teniopteris*, and two other forms of questionable distinctness which the latter author describes from the English beds.^d *Oleandra arctica* Heer ^e from the Kome beds of Greenland may be compared with the Potomac *Teniopteris*. Newberry ^f identifies this species in the

^a Monogr. U. S. Geol. Surv., No. 15, 1890, pl. 29, fig. 9.

^b Saporta, Flora Foss. Portugal, 1894, p. 85, pl. 15, fig. 3; pl. 16, fig. 18.

^c Schenk, Palaeontographica, vol. 19, 1871, p. 221, pl. 29, figs. 6, 7.

^d Seward, Wealden Flora, pt. 1, 1894, pp. 127, 128.

^e Heer, Flora Foss. Arct., vol. 3, pt. 2, 1874, p. 38, pl. 12, figs. 3-11.

^f Newberry, Amer. Journ. Sci. (ser. 3), vol. 41, 1891, p. 201, pl. 14, fig. 9.

Kootenai of Montana, the latter forms at least, being probably identical with the Virginia species.

Occurrence.—PATUXENT FORMATION. Fredericksburg, near Telegraph station and near Potomac Run, Virginia.

Collections.—U. S. National Museum.

THE GENUS NILSONIA OF BRONGNIART.

This genus was founded by Brongniart ^a for certain remains from the Rhætic of Sweden which had been recorded and figured by Nilsson in 1820 who regarded them as fern remains. In the Prodrôme the diagnosis is as follows:

Feuilles pinnées; pinnules rapprochées, oblongues, plus ou moins alongées, arrondies au sommet, adhérentes au rachis par toute la largeur de leur base, à nervures parallèles, dont quelques-unes sont beaucoup plus marquées. ^b

The genus was regarded by Brongniart as referable to the Cycadales a view generally accepted by subsequent workers, although Schenk ^c in 1867, on the basis of supposed sori on some German specimens, referred it to the Filicales, in which he was at first followed by Schimper ^d and more recently by Solms-Laubach. ^e

The genus has also been ably discussed by Saporta, Nathorst, Seward, and others, Nathorst in particular having shown that the two kinds of veins supposed to occur together were due to slight folds in the lamina due to pressure, maceration, or the creep of the enclosing strata. He characterizes the veins as equal and simple and emphasizes the insertion of the lamina on the upper surface of the rachis, suggesting that Schenk's supposed sori are fungal or stomatal in their nature. ^f

The genus may be redefined in the following terms: Frond coriaceous, elongate-lanceolate in outline, entire or commonly more or less deeply pinnatifid by being split, usually to the rachis, into a number of more or less irregular segments which are contiguous, usually broad, and truncate. Lamina attached to the upper surface of the rachis, the simple and parallel equal lateral veins running almost or quite to the median line. In material showing only the under surface of the fronds the stout midrib is prominent and unsegmented specimens are scarcely distinguishable from *Tæniopteris* and allied forms, while the segmented varieties approach *Anomozamites* or even some species of *Pterophyllum* in appearance.

^a Ann. Sci. Nat., vol. 4, 1825, p. 218.

^b Brongniart, Prodrôme, 1828, p. 95.

^c Schenk, Die fossile Flora Grenzsichten Keupers u. Lias Frankens, 1867, p. 124.

^d Schimper, Pal. Végét., vol. 1, 1869, p. 488.

^e Solms-Laubach, Fossil, Botany, 1891, p. 139.

^f See Nathorst, Über die gattung Nilssonia Brongn., Kongl. Svenska Vet. akad. Handl., vol. 43, 1909, No. 12.

The genus *Nilsonia* appears in the Triassic and is particularly a Rhaetic and Oolitic type. A number of undoubted species occur, however, in the Lower Cretaceous, no less than seven different species having been recorded from the Lakota, Kootenai, and Shasta deposits. The Neocomien of Japan furnishes two or three species, while the widespread *Nilsonia schaumburgensis* (Dunker) Nathorst, occurs very abundantly at a number of European Wealden localities. The Upper Cretaceous shows a species in the Atane beds of Greenland and one in the Cenomanien of Bohemia, while several supposed species have been recorded from Tertiary strata.

There are two species in the Potomac group, a lanceolate unsegmented form variously described by Fontaine as *Angiopteridium* and *Sapindopsis* and the large and elegant form which this author describes as two species of *Platypterygium*. The latter term was proposed by Schimper in 1880 as a subgenus of *Anomozamites* for very large forms of that type. It was subsequently used as a genus by Feistmantel and Fontaine although this usage seems unwarranted, especially since the *Platypterygium* forms of *Anomozamites* are all confined to much older horizons and the Potomac forms agree in all essential characters with *Nilsonia*, a relationship suggested by Seward in 1900 after examining the material in the U. S. National Museum. As illustrated by Fontaine the rachis is represented as very wide and the opposite segments are far apart. That the midrib was not wide and flat in life, but prominent below and not out of proportion to the size of the fronds is shown by a most casual examination of the considerably macerated and much flattened specimens.

NILSONIA OREGONENSIS (Fontaine).

Angiopteridium strictinerve FONTAINE, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 240, 511, pl. 66, figs. 5-7; pl. 110, fig. 12 (not Fontaine, 1890).

Sapindopsis oregonensis FONTAINE, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 268, pl. 69, figs. 15-17.

Description.—Fronde simple, unsegmented in all the specimens collected, lanceolate in outline, with equally pointed apex and base. Length apparently about 7 cm. to 15 cm. and greatest width, which is midway between the apex and the base, 1.2 cm. to 1.6 cm. Texture coriaceous. Rachis stout, prominent below. Lateral veins close and parallel, the great majority simple, but an occasional vein forking dichotomously. Angle of divergence large, varying from 55° in the apical part of the frond to 85° in the median and basal portions.

This species is based upon considerable incomplete material from widely separated localities, which afforded the basis for two different species of Fontaine, but which seem to be identical and markedly different from the types to which they were referred. The forms

referred to, *Angiopteridium strictinerve*, are from Virginia and California, while those described as a new species of *Sapindopsis*, which genus they do not resemble in the remotest degree, are from Oregon. The former are quite different from the type of that species, being smaller and less elongate with closer mostly simple veins and with the rachis prominent below and masked above by the lamina of the frond. The latter correspond with the others in outline and venation, differing in outline, venation, and in the character of the rachis from *Sapindopsis*.

The present species, which is confined to the Potomac group and the Shasta of California and Oregon, where it occurs in both the Knoxville and the Horsetown beds, is suggestive of the species from the Neocomien of Japan, which Yokoyama^a identifies as *Nilsonia johnstrupi* Heer.

Occurrence.—PATUXENT FORMATION (?) Chinkapin Hollow, Virginia.—SHASTA FORMATION, California (Tehama County, in Knoxville and Horsetown beds), and Oregon (near Riddles, in Horsetown beds).

NILSONIA DENSINERVE (Fontaine).

Platypterigium densinerve FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 169, pl. 30, fig. 8; pl. 31, figs. 1, 4; pl. 32, figs. 1, 2; pl. 33, fig. 1; pl. 34, fig. 1; pl. 35, figs. 1, 2.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, p. 521, pl. 112, fig. 8.

Platypterigium rogersianum FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 171, pl. 31, fig. 2; pl. 33, fig. 2; pl. 34, fig. 2.

Description.—Fronds large, upward of 50 cm. to 70 cm. in length by 15 cm. to 18 cm. in greatest width, averaging about 12 cm., either entire or more often irregularly divided into rectangular or subrhombic segments, at times somewhat rounded proximad. Texture coriaceous. Rachis stout, prominent below, more or less flattened during fossilization. Laterals of small calibre, close, one-third to 1 mm. apart, parallel, invariably simple and nearly straight, diverging at an angle in the neighborhood of 90°.

This splendid species, presumably because of its large size, is represented only by fragmentary specimens, both the apex and the base being missing. It is not at all common and is entirely confined to the Patuxent and Arundel formations in the Maryland-Virginia area. The specimens show some individual variations in the degree of segmentation and strength and position of the lateral veins, the forms which served as a basis for *Platypterigium rogersianum* of Fontaine, being more robust, but somewhat smaller than the others, with veins somewhat larger in size and less closely placed, but the limits of variation are nevertheless quite restricted.

There can be but little doubt of all of these forms belonging to a single species, such variations as are observable being due to varia-

^a Yokoyama, Journ. Imp. Coll. Sci., Japan, vol. 7, 1895, p. 226, pl. 25, figs. 1-4.

tions in the methods of preservation. At first glance the rachis appears to have been wide and ribbon-like, but this was not the case. The segments are inserted on the upper surface of the rachis in conformity with the generic diagnosis, and in one of the specimens the lateral veins of opposite sides approach to within 1 mm. of each other, being separated by a slightly raised ridge. Ventrally it is seen that the large rachis is flattened and during or since fossilization small fragments of the inner margin of the segments overlying the rachis are more or less flaked off, exposing in places the broadly flattened rachis. In another specimen the segments of one side are still attached centrally to the top of the rachis, which is flattened and pushed over in the opposite direction, the segments of the other side being broken off proximally, again giving the appearance of a broad, flat rachis. In the final report the writer will show photographic reproductions of a number of these forms with cross-sections illustrating the manner of fossilization, and showing conclusively the correctness of the foregoing statements.

Occurrence.—PATUXENT FORMATION, Fredericksburg, Virginia.—ARUNDEL FORMATION, Langdon, District of Columbia.

Collections.—U. S. National Museum.

THE GENUS SAPINDOPSIS OF FONTAINE.

This curious genus was founded by Fontaine ^a in 1890, and referred to the Family Sapindaceæ of the Order Sapindales. It was characterized as follows:

Leaves pinnate, both odd pinnate and abruptly pinnate; terminal leaves usually more or less united at base; upper pairs of leaves decurrent, forming a wing on the common stem, the wing lessening in width on the pairs in descending; leaves mostly opposite in pairs, sometimes subopposite; the lowest pairs lack the wing, and are sometimes short-petioled; leaves thick, with dense and often glossy epidermis, elliptical or lancet-shaped, with a strong prominent midrib, which extends with slight diminution to the tip of the leaf; lateral nerves going off at a large angle, and uniting more or less completely near the margin to form a series of arches; the lateral or primary nerves, as seen on the lower side of the leaves, strong and prominent, but on the upper side, owing to the thickness of the leaves, generally indistinct; the ultimate reticulation is strong, and forms a series of rather large, irregular, polygonal meshes.

Sapindopsis is an important element in the flora of the uppermost member of the Potomac group, the Patapsco formation, to which the genus is exclusively confined, with the single exception that *Sapindopsis variabilis* has been recorded in the nearly homotaxial Fuson formation of Wyoming. No specimens of *Sapindopsis* are known from either the Patuxent or Arundel formations or their equivalents in other parts of North America. It is true that Professor Fontaine described *Sapindopsis cordata* from Fredericksburg, Virginia, but this

^a Fontaine, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 296.

material, which is very poor, is obviously not related to this genus, while the record of *Sapindopsis elliptica* from Fredericksburg by the same author is based upon the remains of *Rogersia longifolia* Fontaine. Likewise the record of *Sapindopsis obtusifolia* from Deep Bottom, Virginia, is based upon fragments of uncertain generic affinity, but doubtfully related to *Sapindopsis*. The genus is notably absent from the fossiliferous Patapsco beds at Federal Hill, Maryland, but when present at a locality it usually occurs in the greatest abundance, as at Fort Foote, Maryland, or in the vicinity of Brooke and Aquia Creek, Virginia, where hundreds of specimens often of great perfection have been collected.

In modification of the diagnosis quoted above it may be said that the vast majority of the leaves are abruptly pinnate and the terminal leaflets, while usually confluent and decurrent, are sometimes petiolate, *Sapindopsis magnifolia* in particular furnishing many individuals lacking the decurrently winged rachis.

The most closely related plants to *Sapindopsis* in the modern flora are the various genera of American Tropical Sapindaceæ. Among these the genus *Matayba* Aublet approaches very near to the Cretaceous form. *Matayba* embraces species with both opposite and alternate leaflets having either entire or dentate margins. The rachis lacks definite alæ, but it is somewhat flattened with a vestigial wing on each side in the form of a raised line which is wider at the point of origin of the leaflets and decurrent to the next lower leaflets. So many other genera of the Sapindaceæ have markedly alate rachises that the presumption is strong that this genus or its ancestors were at some time similarly provided. The most similar species seems to be *Matayba apetala* (Macfarland) Radlkofer, in which the leaflets are usually more numerous than in *Sapindopsis*; although some specimens show but three pairs, those with four pairs are common; they are sometimes subopposite, and as many as seven pairs are met with. The venation is exactly like that of the fossils, as is the texture of the leaves and their limits of variation. Another closely related species is *Matayba domingensis* Radlkofer, also a native of the West Indies.

It is exceedingly satisfactory to be able to establish upon a somewhat firmer basis Professor Fontaine's choice of the term *Sapindopsis* for these Potomac plants. They are so abundant in their occurrence, so striking in appearance, their strict habit and glossy texture giving them every appearance of some fern-like plant, as, for example, the common *Acrostichum aureum* of the Tropics, that their original describer deserves great credit for having correctly determined their modern affinities.

SAPINDOPSIS VARIABILIS Fontaine emend.

Sapindopsis variabilis FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 298, pl. 151, fig. 1; pl. 152, figs. 1, 4; pl. 153, fig. 3; pl. 154, figs. 2-4; pl. 155, figs. 2-5.—FONTAINE, in WARD, 19th Ann. Rept. U. S. Geol. Surv., 1899, pt. 2, p. 690, pl. 169, fig. 9; Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 481, 482, 489, 532, pl. 114, fig. 2.

Sapindopsis parvifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 300, pl. 154, fig. 6.

Description.—Leaves odd pinnate, sometimes abruptly pinnate, with three pairs of lateral leaflets, which may be opposite, although usually there is a tendency toward a subopposite arrangement, markedly so in several specimens. Leaflets normally lanceolate, individuals of the same leaf about of a size, usually markedly decurrent, but variable in this respect. The proximal leaflets are always less decurrent than the pair next above, and in some cases even have short petioles. The upper leaflets are remarkably variable, sometimes with an abnormal decurrent wing which joins the inner lamina of the next lower pair of leaflets; at other times the rachis entirely lacks a wing. The leaf may be terminated abruptly by a pair of leaflets variously coalesced or the three apical leaflets may be variously united, their lamina may be almost symmetrical or markedly inequilateral, their margins showing a tendency toward undulation, and occasionally a leaflet is divided into a basal and an apical part by a sharp constriction on one side near the middle of the blade, ranging in size from the small forms upon which Fontaine founded his species *Sapindopsis parvifolia* and which are 1.6 cm. long and 0.4 cm. wide to forms which approach *Sapindopsis magnifolia* in size and are 10 cm. long and 1.5 cm. wide. The average dimensions of a large number of specimens are, however, 6 to 7 cm. long by 1 to 1.3 cm. wide.

Leaves thick, with smooth surface. Rachis and midrib stout. Venation more prominent than in the other species, but still very faint, with the exception of the secondaries, which while fine are more conspicuous than in the other species. Secondaries forming a wide angle with the midrib, nearly straight for two-thirds of the distance to the margin, where they bend sharply upward and join the secondary next above by a but slightly curved arch. As the secondaries are numerous and almost uniformly spaced the venation has much the appearance of a *Eucalyptus*, except that the marginal hem is much broader than in that genus.

This species is exceedingly abundant at various localities in the Patapsco formation and is by far the most characteristic species of that formation, although it has not been detected at certain other undoubted Patapsco horizons. It is the only species of the genus which has been recorded outside of the Maryland-Virginia area, occurring in the Fuson formation along Oak Creek, Wyoming, where

it is the most abundant species found, just as it is at White House Bluff, Brooke, and Aquia Creek, Virginia, and at Fort Foote, Maryland.

It is an exceedingly variable form in all its details, and as during maceration the most variable apical portion is the last to be destroyed this variability is emphasized in fragmentary material such as that usually collected. When well preserved it furnishes most characteristic specimens. In life its rigid pinnate leaves and strict appearance must have given it a very striking aspect.

Occurrence.—PATAPSCO FORMATION. Fort Foote (over 100 specimens), Prince George County, Maryland; near Brooke, White House Bluff, Mount Vernon, 72d milepost, Aquia Creek, and near Widewater, Virginia.—FUSON FORMATION. Oak Creek, Wyoming (abundant at all of the foregoing localities).

Collections.—U. S. National Museum, Johns Hopkins University.

SAPINDOPSIS MAGNIFOLIA Fontaine emend.

Sapindopsis magnifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 297, pl. 151, figs. 2, 3; pl. 152, figs. 2, 3; pl. 153, fig. 2; pl. 154, figs. 1, 5; pl. 155, fig. 6.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 481, 482, 528.

?*Aralia dubia* FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 314, pl. 157, figs. 1, 7 (not Schimper, 1874).

Ficophyllum eucalyptoides FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 291, pl. 164, figs. 1, 2.

Sapindopsis tenuinervis FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 301, pl. 153, fig. 1.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1906, pp. 489, 528.

?*Aralia fontainei* KNOWLTON, Bull. No. 152, U. S. Geol. Surv., 1898, p. 37.

Sapindopsis obtusifolia FONTAINE, 1890, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 301, pl. 156, fig. 13; pl. 159, figs. 3-6.

Ficophyllum eucalyptoides FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1906, p. 489.

Description.—Leaves commonly odd pinnate, although occasional abruptly pinnate forms occur, of considerable size, but somewhat variable, however, in this respect. Leaflets 3 pairs, comparatively large, lanceolate, tapering almost equally toward the apex and base, the latter inequilateral except in the terminal leaflets, pointed, often lacking apical portions, length increasing proximad, averaging about 10 cm., longest seen 14 cm. (estimated), shortest 5 cm., width varying from 1.1 to 3.2 cm., inequilateral, since the outer half of the lamina is broader than the inner half and is markedly decurrent. This feature is least emphasized in the basal leaves which may even have a considerable petiole, but becomes increasingly pronounced distad, the terminal leaflets often forming a bilobate or trilobate whole with the outer margins broadly decurrent and joining the lamina of the leaflet next below at the point of juncture of its inner margin with

the rachis. Certain specimens show all of the leaflets petiolate, a feature much emphasized in specimens collected recently on Stump Neck, Maryland, in which the petioles are 3 to 4 cm. in length. The leaflets in this species are much oftener petiolate and lacking in the winged rachis than in *Sapindopsis variabilis*, in these features closely resembling the leaves of the modern *Matayba apetala* in which the rachial wings are vestigial. Leaf substance thick and leathery, epidermis firm and glossy.

Leaflets commonly subopposite, often markedly so, forming an acute angle with the rachis. Midribs stout and prominent below. Secondaries slender, only seen on the under surface of the leaflets and even then made out with difficulty, 8 to 10 pairs, branching from the midrib at a rather wide angle especially in the central part of the leaf, the angle is more acute basally, curving upward ultimately to join a short branch of the secondary next above. Tertiaries fine, forming lax subrhombic areolæ where visible.

This species is very common at certain localities within the Patuxent formation, as, for example, on Stump Neck, in Charles County, Maryland, although at other outcrops of this same formation it has not been detected. This is notably the case in the Federal Hill deposits, from which large collections have been made without disclosing a single specimen. Evidently the species was local in its distribution, which is emphasized by its total absence in any other Lower Cretaceous deposit either here or abroad.

The grounds for the separation of this species from *Sapindopsis variabilis* are slight, since both are variable and the larger forms of the latter are quite as large as the smaller forms of *Sapindopsis magnifolia*. In the Potomac they are found in association at all the localities where either occur, and the smaller species is usually the most common as if *Sapindopsis magnifolia* represented the occasional more robust forms of that species. On the other hand, the latter has not been detected in the abundant remains of *Sapindopsis variabilis* found at Oak Creek, Wyoming, and there is commonly considerable disparity in size between the two. There are certain other differences which appear to be constant. These are the thicker relatively longer leaflets of *Sapindopsis magnifolia* with less numerous and somewhat more ascending secondaries which are not connected distally by relatively flat arches. The writer includes under this species the *Sapindopsis tenuinervis* of Fontaine, recorded from the localities near Brooke, Virginia, and from Fort Foote, Maryland. The only apparent ground for its erection was a fancied difference in venation based chiefly on a more slender midrib and more remote leaflets, both characters which are seen to be variable and altogether unreliable as soon as any number of specimens are compared.

The specimen from Deep Bottom, Virginia, which is the most southerly outcrop of the Patapsco formation known and the only one of this age in the James River Valley, forming the basis for the species *Aralia dubia* Fontaine (*Aralia fontainei* Knowlton), is doubtfully included under the synonymy of this species, since it appears to represent a macerated and distorted specimen of the terminal leaflets of a large *Sapindopsis*. There is certainly no ground for retaining it in the genus *Aralia*. Likewise the specimens which formed the basis for *Ficophyllum eucalyptoides* Fontaine are clearly referable to this species of *Sapindopsis* and have nothing in common with *Ficophyllum*.

Occurrence.—PATAPSCO FORMATION. Near Brooke, 72d milepost, near 72d milepost, Deep Bottom (?), near Widewater and Aquia Creek, White House Bluff, Virginia,^a Stump Neck and Fort Foote, Maryland.

Collections.—U. S. National Museum, Johns Hopkins University.

SAPINDOPSIS BREVIFOLIA Fontaine.

Sapindopsis brevifolia FONTAINE, Monogr. U. S. Geol. Surv., No. 15, 1890, p. 300, pl. 153, fig. 4; pl. 155, figs. 1, 7; pl. 163, fig. 3.—FONTAINE, in WARD, Monogr. U. S. Geol. Surv., No. 48, 1905, pp. 481, 482, 528.

Description.—Leaves odd-pinnate, the terminal leaflet considerably larger than the lateral leaflets of which but two pairs are known. These are opposite. Leaflets somewhat crowded, so that their margins often overlap, with subacute tips, varying in length from 2 to 5 cm. and in width from 0.8 to 1.6 cm., averaging about 3 cm. long by 1.3 cm. wide. Inequilateral toward the base and showing considerable variation in decurrence even among the few specimens known, in some the rachis is conspicuously winged, while in others the leaflets are all petioled, the whole having the aspect of some member of the Leguminosæ. Midribs stout, secondaries ascending, camptodrome, seen with difficulty, since the leaf texture is coriaceous.

This is a poorly marked species of infrequent occurrence at the same localities where the other species of this genus occur and may simply represent variant forms of the abundant *Sapindopsis variabilis*.

Occurrence.—PATAPSCO FORMATION. Near Brooke, 72d milepost, Aquia Creek, Virginia; Fort Foote, Maryland.

Collections.—U. S. National Museum, Johns Hopkins University.

^a The table on page 586 of Monogr. 48, U. S. Geol. Surv., gives Colechester road as an additional locality for this species. This occurrence is not mentioned in the text, and the writer has failed to locate the specimen, if one existed, among the fragmentary material from this locality.